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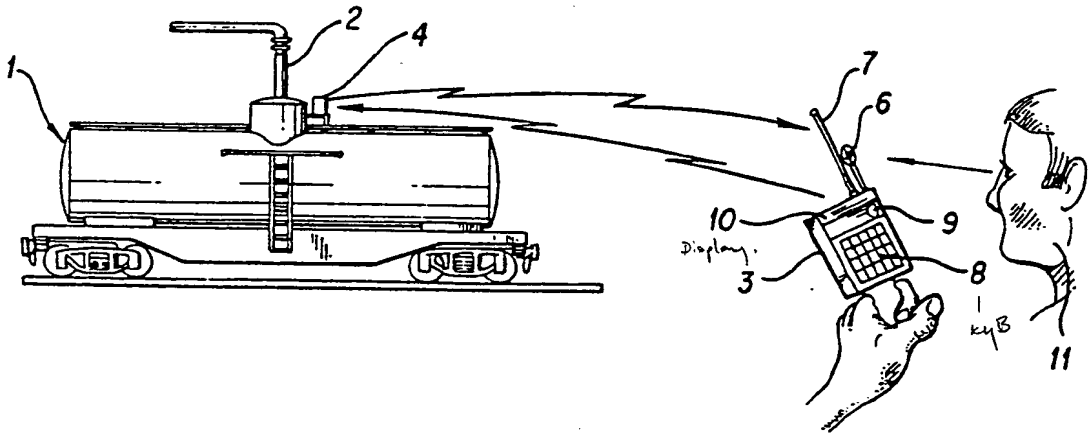

(57) Abstract

An electronic remote chemical identification system, in which a transponder for recording information regarding the contents of a railroad tank car, highway tank truck or other container is placed hereon, the transponder being coded with said information and interrogated when desired by a remotely located coder/interrogator unit. In the case of an accident, emergency response personnel can utilize the coder/interrogator to interrogate the transponders of damaged tank cars or the like to safely and immediately ascertain the exact contents of the containers, as well as the proper emergency responses required at the scene. Similarly, the system can be used in normal commerce to inventory the contents of a passing freight train or truck.

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ELECTRONIC REMOTE CHEMICAL IDENTIFICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

There have been several major transportation accidents in the United States involving the release of hazardous chemicals, followed by spectacular fires and explosions, dispersion of toxic vapors, extensive property damage and potential ground water pollution. In many of these incidents, there has been injury to people and/or loss of human life. Property and environmental damage has been estimated in the hundreds of millions of dollars. Many of these catastrophes have involved railroad tank cars and tractor-trailer tank trucks transporting hazardous chemicals. The transportation of hazardous chemicals in the United States on railroads, roads, highways and waterways is regulated by various agencies of the U.S. Department of Transportation, as well as by state and local bodies. These agencies have instituted numerous regulations to reduce accident frequency, severity and public impact.

These regulations stipulate technological modifications as well as operations and management changes in the transportation of hazardous chemicals to provide safety to the public. For example, one regulation requests the carrying of bills of lading or waybills identifying the chemicals being transported. The railroads, for example, have become conscious of potential public hazards and economic costs resulting from accidental chemical releases, and have undertaken changes in operational procedures, development of contingency plans, and have instituted emergency response management procedures to cope with hazardous materials accidents. Truck fleet operators also are considering various operational measures to reduce tractor-trailer accidents involving chemicals.

Unfortunately, major transportation accidents involving hazardous chemicals continue to occur. One of the major problems associated with railroad accidents involving hazardous materials in tank cars and their accidental release is the proper identification of the chemicals being transported. The National Transportation of the chemicals being transported. The National Transporation Safety Board and the National Fire Protection Association have repeatedly pointed out that emergency response personnel need immediate, accurate information concerning the materials involved, and guidance in the handling of transportation emergenices involving hazardous materials.

The National Transporation Safety Board noted in a recent investigation (NTSB-RAR-79-1) that "Fire fighters experienced a forty-five minute delay in obtaining the waybills and consist information with pertinent hazardous materials emergency information. This delay could have had serious consequences, particularly if they had attempted to fight the fire before the second explosion. Fire fighters should have known immediately where to find the train's hazardous materials information. Also, if the crew members had been injured, a longer delay in obtaining the information would have occurred. If the crew members had been killed or injured, there was no identified location where the consist information could be obtained from."

Also in 1979, in a train derailment in Mississaga, Canada, lack of identificaiton of the leaking chemicals for over eight hours led to considerable confusion as to the proper emergency respone actions to be taken. Finally, after the chemical was identified as chlorine, over 250,000 people were evacuated--the largest evacuation due to a hazardous materials incident in North America.

The initiation of emergency action in evacuation of inhabitants from potential hazard zones surrounding a train derailment involving several chemical cars in Livingston, Louisiana in 1981 was also delayed by several hours, to almost a day, because of the inability of emergency personnel to identify the chemicals in the derailed cars.

The initiation of emergency action in evacuation of inhabitants from potential hazard zones surrounding a train derailment involving several chemical cars in Livingston, Louisiana in 1981 was also delayed by several hours, to almost a day, because of the inability of emergency personnel to identify the chemicals in the derailed cars. Placards attached to the cars identifying their contents were lost, and the car sequences were jumbled as a result of the accident, making identification of contents extremely difficult, even though the waybill for the train was available. There have been serveral such incidents relating to highway and road trucks in which the single major problem in initiating an emergency response was the lack of knowledge of the contents of the damaged vehicles on the part of first responders on the scene.

2. Description of the Prior Art

At present, indirect methods are virtually the only means available for identifying the chemicals contained in tank cars. These methods include: reading labels and placards; identifying contents by size, shape and type of container; reading package or container markings; obtaining and reading shipping papers; contacting transportation personnel; contacting CHEMTREC (Chemical Transportation Emergency Center); and utilization of existing emergency guides, cards or manuals.

In the rare cases in which a chemical has been released, and appropriate measuring instruments are available to emergency response personnel, a positive identification of the leading chemical may be made. But even in this case, the instruments may be useless if multiple chemicals have been released, or if there is fire or smoke obscuration.

Several of the indirect methods give information only as to classes of hazardous materials and not the identity of the specific chemicals involved. The new Department of Transportation identification numbering system is intended to aid in positive identification through placards; but this system has neither been completely implemented on all tank cars and highway tank trucks, nor is the system failsafe in an accident. For example, the placard numbers can be erased due to mechanical scraping in an accident, or obscured by smoke and soot deposits in a fire. In many instances, the placards are mechanically released from the tank car structure, and may lie far away from the accident. Heat or danger of explosion may prevent close enough access to read identifying information. Bills of lading may be unavailable, lost, or may indicate insufficient information. In the case of multiple car derailments, the locations of tank cars are invariably jumbled. This makes it very difficult, if not impossible, to identify the cars from the train consist papers, which only list tank cars sequentially from the locomotive. In the case

of highway tank trucks, the placard system leads to confusion and possible erroneous response action when a tank truck containing multiple chemicals is involved in an accident. The partitioning of the tank trucks necessary to avoid a large free surface liquid area allows these trucks to carry several different cargoes, and to have several different placards. The indirect methods of chemical identification are at best inadequate, and at worst, lead to exacerbation of the catastrophe due to incorrect identification and initiation of incorrect action. In short, these indirect methods of chemical identification in an accident are ineffective, and may pose potential hazards to emergency response personnel.

Another problem with the placarding system presently in use involves the lack of uniformity regarding placarding regulations between the United States and it neighboring nations of Canada and Mexico. Frequently, hazardous materials which are properly placarded and transported within the United States are turned back at the Canadian and Mexican borders when the placarding standards for the materials involved differ between the two countries.

Yet another problem with the present placarding system is the "open" nature of the system. This system allows terrorists to easily identify dangerous or explosive chemicals being transported through populous areas, and could conceivably allow such terrorists to use such chemicals being transported to endanger large numbers of the civilian population.

Active techniques of chemical identification available at present are useful only if the chemical has been released. These techniques are used for determining the concentration of the chemical in the atmosphere, rather than for strict identification. Most methods used in accident situations rely on remote sensing technologies which utilize electromagnetic radiation in one form or another. Typically, the interaction between the particular chemical in the atmosphere and the radiation emitted by a sensor in the infrared, visible or ultraviolet region of the spectrum is sensed. Identification principles are based on absorption, emission or scattering of spectral characteristics of the radiation. Many systems developed for air pollution studies use laser beams as sources of high intensity coherent radiation.

Unfortunately, while these techniques work very well under controlled conditions in a laboratory, their usefulness in the field is limited by various practical, logistical and cost-related difficulties, especially where unexpected and accidental chemical release conditions are concerned. Many of these systems are bulky, expensive, and not readily available at the accident site in a timely manner.

A survey conducted by Gross et al in 1982 for the Federal Emergency Management Administration of the actual experiences of a group of emergency response workers, indicates that in 33 per cent of the accidents, the placards were not visible, and in 52 per cent of the incidents, the manifest information was

unavailable on a timely basis. Furthermore, the survey indicates that in the opinion of emergency personnel, while the quantative information on the concentrations of hazardous vapors was deemed desirable, the first priority was to identify the chemicals in the tank cars. Most of the research work at present is focused on developing more accurate methods of determining flammable or toxic vapor concentrations in the air subsequent to a chemical release, and not much effort (other than placarding) has been expended in developing techniques for identifying the chemical in its contained state.

SUMMARY OF THE INVENTION

The key questions facing the first emergency workers on the scene at a hazardous materials transportation accident involving a highway tank truck or multiple rail tank car derailment and a chemical spill include: 1) What are the chemicals? 2) Are they hazardous, poisonous, toxic or corrosive? and 3) Are they flammable or likely to explode? The rapidity of response and the nature of corrective actions initiated, including evacuation and relocation of nearby inhabitants, will depend very crucially on the proper identification of the chemicals, knowledge of their physical and chemical properties, and their behavior in the environment. The reduction of threat to life and property will depend to a large extent on the initial corrective action taken by emergency response teams arriving at the scene of a transportation accident involving either the release or potential release of a chemical. The corrective action has to be proper and timely so as not to exacerbate the situation. Many accident investigators have recognized the need for reliable chemical identification in accidents. The National Transportation Safety Board has repeatedly recommended that both regulatory agencies and other institutions support research efforts for chemical identification and for improving procedures and records on chemical consists in a train or truck transporting hazardous materials.

It is an object of this invention to provide an electronic remote chemical identification system capable of delivering upon demand to emergency response personnel information about the chemical being carried in a particular tank car, tank truck, barge or ship, such as its Department or Transportation chemical number, the chemical name, the shipper or manufacturer's name, and even detailed information as to the actions to be taken involving a spill of the specific chemical.

It is another object of this invention to provide a chemical identification system for meeting all the present standards of identification currently required, and also precluding identification of said chemicals during transport by groups such as terrorists who might have illicit uses for such information.

The system involves a transponder attached to each vehicle or tank car, which transponder is coded for the particular chemical being transported by the shipper or manufacturer at the time the car is loaded, and a master inquirer unit used at the accident scene to activate the transponder and decode its information.

This same system can also be used during the normal commerce of transporting chemicals and commodities to identify the cargo in non-accident situations.

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This same system can also be used during the normal commerce of transporting chemicals and commodities to identify the cargo in non-accident situations. Further uses to which this system can be applied include automatic classification of tank cars in classification yards, position location of tank cars, tank trucks or other vehicles utilizing a satellite-mounted interrogator, and taking of surveys of passing trains or truck traffic for statistical or regulatory purposes.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view depicting the programming of a transponder unit during loading of a rail tank car;

Figure 2 is a top plan view of a railroad derailment accident site;

Figures 3A and 3B are front and side plan views of the hand-held interrogator unit:

Figures 4A is a block diagram of the interrogator-coder circuit; and

Figure 4B is a block diagram of the master coder circuit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The principle purpose of the electronic remote chemical identification system is the same as placarding on a hazardous materials car, that is, to provide readily the name of the chemical being transported to emergency response personnel at an accident scene and, likewise, to provide the same information to supervisory personnel during normal, non-accident situations in commerce and trade. This system is, however, based on the principle of remote identification, and can be made much less vulnerable to damage and loss in an accident. It is based on the principle that a suitably protected transponder can be provided on each tank car or truck containing hazardous materials. This transponder can be electronically programmed with information about the chemical being carried in that particular tank car, tank truck or partitioned tank, such as the Department of Transportation chemical number, the chemical name, shipper or manufacturer's name, and any other information of importance. In the case of an accident, the information in the transponder can be retrieved at a safe distance from the accident location by an interrogator or inquirer. The interrogator commands the transponder by radio signals to respond with the information stored in its memory. The signals received by the interrogator are interpreted and displayed on a small screen, such as that of a pocket calculator. The display will show the chemical name, DOT number, the shipper's name and any other information that may be helpful to the emergency response personnel.

The interrogator can also be used during routine and normal transportation of hazardous materials to query the tank cars or trucks for identification of their contents in transit for inventory or other purposes. In the case of a derailment or road truck accident, police, fire or other emergency responders can use portable interrogators from a safe distance from the accident for quick and positive identification of a chemical.

The electronic remote chemical identification system consists of three principle components: 1) the transponder; 2) the master coder; and 3) the interrogator or master inquirer. The master coder and the interrogator can be incorporated in the same unit.

The transponder is a small microprocessor device powered by rechargeable solar batteries. The transponder is normally inactive. It may be enclosed, except for a small radiating antenna, in a protective, box, permanently attached at a convenient and protected location on the tank car or tank truck. The transponder will receive and transmit digitized radio signals on command only from a master coder or an interrogator.

The master coder and interrogator are similar in size to a pocket calculator, with an antenna, an alphanumeric keyboard, and display screen.

Each tank car carrying hazardous materials or any other cargo whose identificaiton is necessary is fitted with a transponder. At the time the car is filled with a chemical, the shipper will key in the name of the chemical, the shipper's name, and other information on the master coder. In operations where large numbers of tank cars are filled with the same chemical, the key-in

procedure may be replaced by including a read head in the transponder, and utilizing a precoded magnetic card inserted into the read head during the initial coding prodedure. Other key-in procedures may include ultrasonic device-based coding of individual tank car transponders.

In case of an accident, the hand-held interrogator brought to the scene by emergency response personnel will provide all necessary chemical identification. A fireman or policeman can obtain this information at a safe distance of up to 500 meters from the accident by interrogating the individual tank car transponders and decoding their transmitted information.

Two methods are described for interrogator operation. The first is to provide the interrogator with a highly directional antenna and sighting means such that the interrogator can be aimed at a specific tank car, and will receive information from that car only. The second method involves storage of the names of all commonly transported chemicals in the memory of the interrogator. At the accident scene, emergency personnel will approach to within 500 meters of the accident sight and switch on the device. The interrogator then sends digital signals corresponding to each of the chemical names stored, commanding simultaneous responses from all transponders on the tank cars preprogrammed with the names of the chemicals being carried. The transponders simply reply YES or NO to the questions asked by the interrogator, and the interrogator then compiles a list of the chemicals for which it receives a YES signal. To pinpoint the cars containing particular chemicals of interest, the

specific chemical is keyed into the interrogator, and the interrogator display will indicate an angular bearing on a null meter between the interrogator direction and the cars containing the chemical of interest. This same procedure can be employed with an interrogator in a helicopter over the accident scene.

Referring now to Figure 1, a railway tank car 1 is shown at a loading site being filled with a hazardous material through fill pipe 2. At this time, a foreman 11 or other personnel utilizes an interrogator-coder 3 to code transponder unit 4 with the proper identifying codes for the particular chemical to be transported. As mentioned earlier, these codes can be entered individually by the foreman through the use of alphanumeric keyboard 8, or alternatively, as when a plurality of tank cars or trucks are being filled with the same chemical, pre-coded magnetic card with the required information may be used.

As mentioned previously, the interrogator mode of operation may be used simply for surveying or inventoring a rolling stock, but the most important usage occurs in the event of a highway accident or railway car derailments as depicted in Figure 2. A plurality of railway tank cars, 1A through 1D, are shown derailed following an accident. They may be damaged or leaking, and emergency response personnel arriving on the scene must first ascertain the nature of the chemicals being carried before emergency operations can proceed. These personnel, using a hand-held interrogator unit 3, can interrogate the transponder units 2A through 2D on all of the derailed

tank cars, and immediately ascertain the cargoes being carried so that proper emergency procedures may be performed.

Figures 3A and 3B show in detail the hand-held interrogator-coder unit. It includes a handgrip 5 to facilitate its use, and a gun sight 6A, 6B as an aid in aiming the unit at the desired tank car transponder unit being interrogated. A whip antenna 7 is provided for receiving the returned signal from the transponder. Other features include a keyboard 8 to allow coding of the transponder at the loading station, and also selection of specific chemical names to be interrogated. Null meter 9 is utilized as a directional aid in locating the cars containing specific chemicals once the initial interrogation and chemical lists have been completed. The initial interrogation involves queries of the transponders 2 from the list of all chemicals contained in the memory of the interrogator-coder. YES and NO responses are noted with respect to each of said chemicals, and then the interrogator 3 is programmed to locate a specific chemical through the use of the null meter 9 and directional gun site 6.

Once a specific tank car and its cargo are identified, a liquid crystal display screen 10, capable of displaying several lines of alphanumeric characters, allows direct display of the information identifying the chemical cargo being carried in the tank car, as well as any specific instructions regarding its handling.

Figure 4A is a block diagram of the interrogator-coder circuit. The heart of the system is the microprocessor 12. It controls all the functions of the unit, and in conjunction with the timing and interrupt control 13, performs proper synchronization of all operations. The program memory and scratch pad memory 14 allows the sequential performance of all the necessary functions of the interrogator-coder. During initial coding operation, keyboard 8 is utilized to program non-volatile random access memory 15 with all necessary information regarding the chemicals to be transported, DOT number, shipper's name and any other information regarding the handling of the chemical. During the coding operation, the UART circuit 16, under control of CPU 12, translates the coded information for transfer by transmitter/receiver 17 and antenna 7 to tank car-mounted transponder 2. In the interrogator mode, CPU 12 directs UART 16 and transmitter/receiver 17 to query any transponder 2 with respect to the chemicals stored in memory 15. Responses are received and processed under control of CPU 12, and the results displayed on display screen 10.

A separate block diagram for the master coder is shown in Figure 4B. While the functions of master coder and interrogator may be physically separated, and provided by different hand-held units, it is deemed desirable and more practical to combine their functions in a single apparatus as illustrated in the drawings.

The transponder unit is similar in construction to that of the master interrogator-coder, in that it also is controlled by a small microprocessor operating in conjunction with a small onboard memory and transmitter/receiver circuit. The entire unit is battery-operated, and in order to conserve battery life, it is recharged by a small solar panel located atop the transponder. It is also designed with a minimum amount of hardware in order to further conserve battery life, with most of its intelligence being generated by software. The transmitter/receiver circuit is normally in the receive mode, unless specific transmitting instructions are received from the interrogator. Also included is non-volatile auxiliary memory to retain the coded information from the master coder even in the event of power loss or unit failure.

In use, master interrogator-coder 3 is utilized at the time of filling of a tank car 1 or the like to code transponder 4 with all necessary information regarding the chemical being transported, the shipper's name, and other information regarding the handling of the chemical. If, during transport an accident or derailment should occur, emergency response personnel arriving on the scene may utilize the interrogator-coder to identify and locate any chemicals which may have been involved in the accident. Once chemicals are identified, the unit can also provide emergency response personnel with any pertinent information regarding the handling of the chemicals during clean-up and restoration of the crash site.

WHAT IS CLAIMED IS:

1. An electronic remote chemical identification system consisting of a transponder unit for mounting on a chemical container; a memory unit associated with said transponder unit; a coder unit for programming said memory unit with information relating to the material being transported; and an interrogator unit for interrogating said memory in said transponder to cause said transponder to relay said information relating to the material being transported to said interrogator.

2. An electronic remote chemical identification system as described in Claim 1, in which said transponder memory is programmed by said coder with information relating to the material being transported, as well as any information necessary for the safe handling of said material should an accident or spill occur.

3. An electronic remote chemical identification system as described in Claim 1, in which said interrogator unit for interrogating said transponder to cause it to relay said information to said interrogator includes means for decoding and displaying said information for immediate use by emergency response personnel at an accident site, as well as for use by supervisory personnel or control equipment during normal transport of chemicals and other materials in day-to-day commerce.

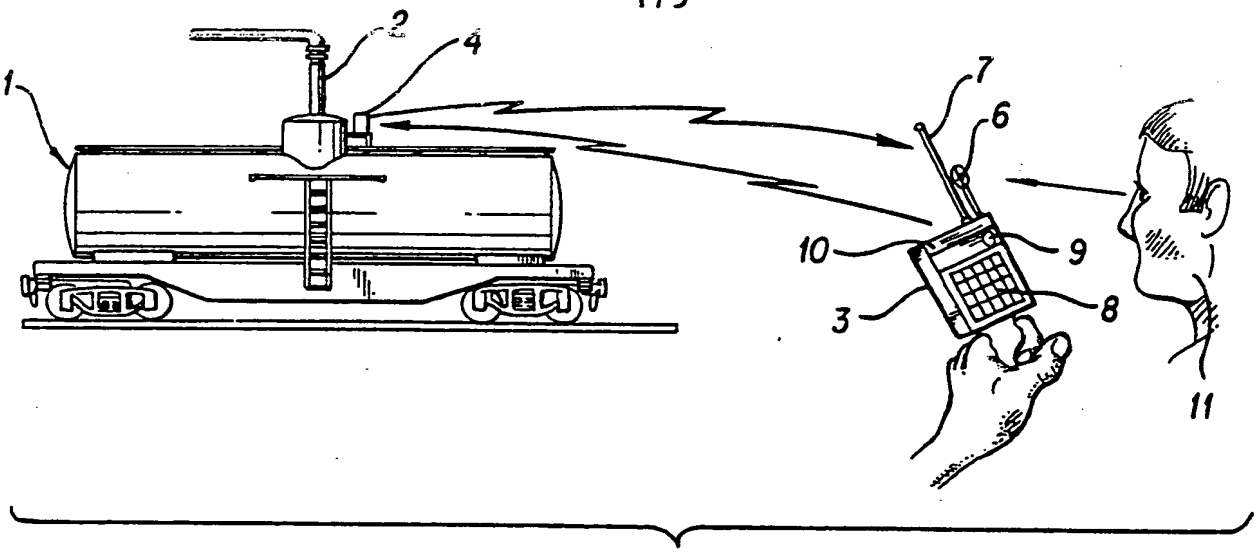

FIG. 1

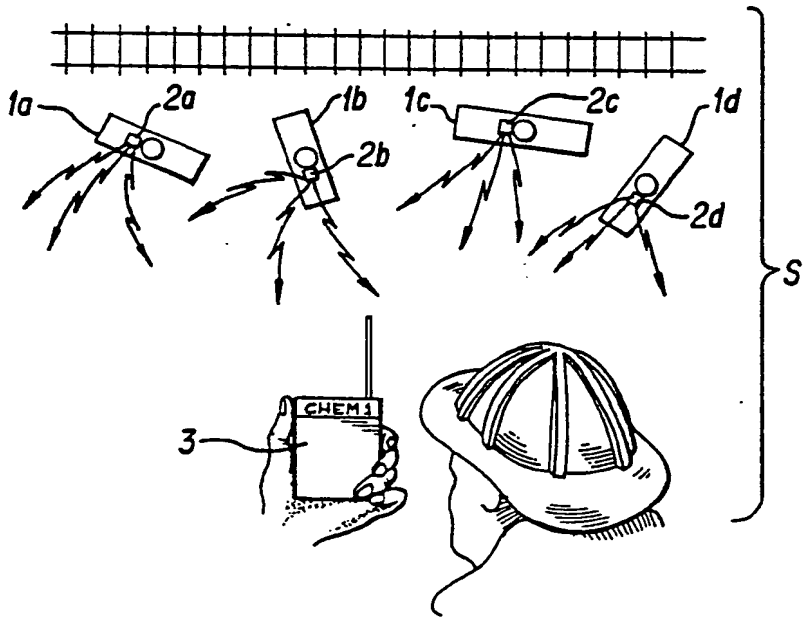

FIG. 2

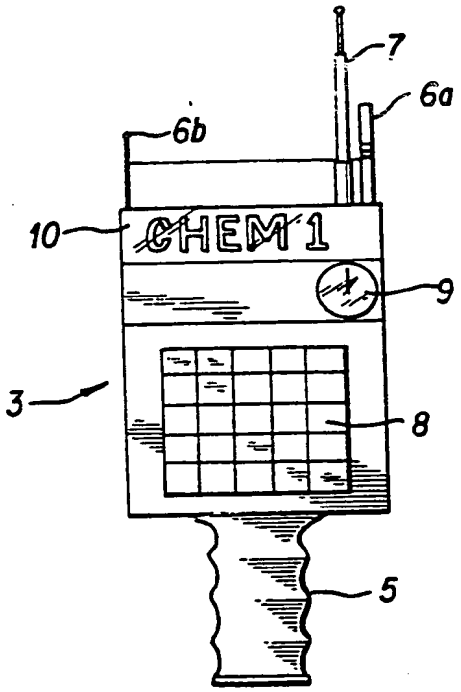

FIG. 3a

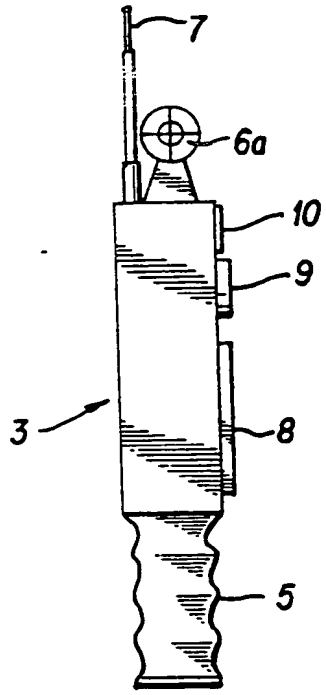

FIG. 3b

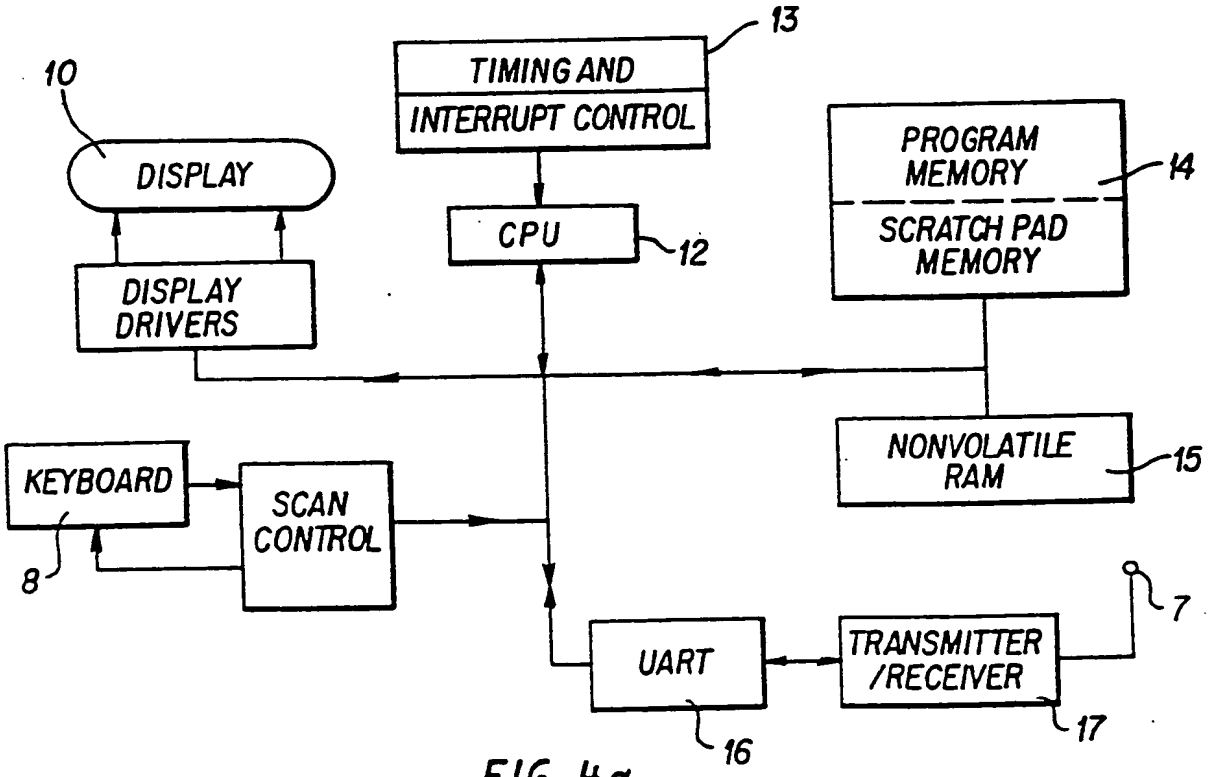

FIG. 4a

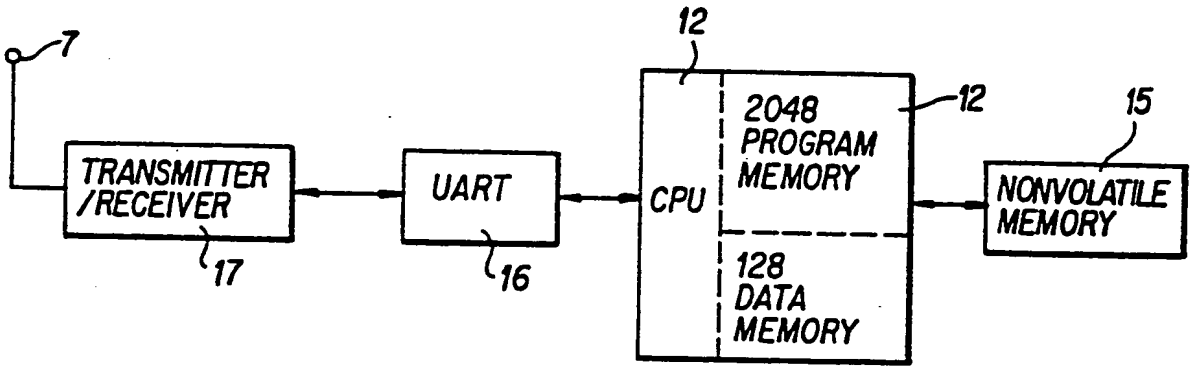
7
TRANSMITTER /RECEIVER
17
UART
16
12
CPU
2048 PROGRAM MEMORY
128 DATA MEMORY
12
15
NONVOLATILE MEMORY

FIG. 4b

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 86/02008

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: G 07 C 9/00; B 61 L 25/04; G 01 S 13/74

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	G 07 C; B 61 L; G 01 S; G 06 F

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, A, 3242551 (GOTTING) 26 May 1983, see page 13, line 25 - page 15, line 16; page 18, lines 21-27; page 23, line 19 - page 24, line 11; figure	1
A	--	2,3
X,P	DE, A, 3412588 (BALLUFF) 24 October 1985, see page 8, line 10 - page 10, line 4; page 14, line 21 - page 15, line 25; page 17, line 6 - page 18, line 11; figure	1
A,P	--	2,3
A	GB, A, 2077555 (STANDARD TELEPHONES AND CABLES) 16 December 1981, see page 1, lines 11-26,100 - page 2, line 93; page 3, lines 23-62; figure	1-3
	--	
A	DE, A, 2739660 (STIFTELSEN INSTITUTET FÖR MIKROVAAGSTEKNIK VID TEKNISKA HÖGSKOLAN) 9 March 1978, see page 6, line 10 - page 7, line 26; figure	1
	--	./.

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
26th January 1987	19 FEV. 1987
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. VAN MOL

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	WO, A, 85/00454 (IMPERIAL CHEMICAL INDUSTRIES) 31 January 1985, see page 1, line 12 - page 2, line 19; page 3, line 6 - page 5, line 13; figure --	1,2
A	US, A, 4090247 (MARTIN) 16 May 1978	

ANNEX TO THE INT[redacted]ATIONAL SEARCH REPORT O[redacted]

INTERNATIONAL APPLICATION NO. PCT/US 86/02008 (SA 14797)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 05/02/87

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A- 3242551	26/05/83	EP-A-	0111753	27/06/84
DE-A- 3412588	24/10/85	None		
GB-A- 2077555	16/12/81	None		
DE-A- 2739660	09/03/78	FR-A,B	2363946	31/03/78
		GB-A-	1555606	14/11/79
		JP-A-	53059448	29/05/78
		SE-B-	417026	16/02/81
		SE-A-	7609732	03/03/78
		US-A-	4390880	28/06/83
		DE-A-	2612996	07/10/76
		FR-A,B	2313824	31/12/76
		GB-A-	1538157	10/01/79
		JP-A-	51142293	07/12/76
		US-A-	4242661	30/12/80
		SE-A-	7503620	28/09/76
		SE-B-	389414	01/11/76
		SE-A-	7600204	13/07/77
		SE-B-	399328	06/02/78
WO-A- 8500454	31/01/85	AU-A-	3109984	07/02/85
		EP-A-	0150199	07/08/85
		JP-T-	60502050	28/11/85
US-A- 4090247	16/05/78	US-A-	4125871	14/11/78

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